Space Weather Technical Forecast

Issued on Thursday, 08 December 2022 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-Class flares throughout. Chance of G1/Minor Storms Day 1. Increasing chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the past 24 hours, with occasional low level C-class flares, including a peak C5.8 at 07/1304 UTC originating from AR3157. There are nine sunspot regions on the visible disc, dominated by a large region in the south centre disk, AR3153, which despite its size remains relatively stable. AR3157 also has a small delta spot in one of its intermediate spots. The remaining spots on the disk have shown either little activity or slight decay.
No Earth-directed CMEs have been seen in available satellite imagery. Although a couple of recent CMEs are being assessed, these are currently considered unlikely to have an Earth directed component.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by DSCOVR, showed the onset of a HSS from CH53, perhaps combined with some weak transient influence. Wind speeds rose steadily from ambient levels around 360 km/s to elevated levels near 550 km/s. The density was above average with a peak of 51ppcc at 07/1440 UTC. The IMF (Bt) was mainly moderate but became strong between 07/1420-1830 UTC with a peak of 20 nT around 07/1540 UTC. The north-south component (Bz) was moderately southward directed at first, before becoming more variable, but often northward directed. The phi angle was mostly negative (towards the Sun), with some variations to positive. Geomagnetic activity showed two G1/Minor Storm intervals between 07/1200-1800 UTC, but has been Quiet to Unsettled since.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2 MeV), as observed by GOES16, was initially at high levels, peaking at 2500 pfu at 07/1310 UTC. Flux fell to Background levels around 07/1745 UTC where it has remained.The associated 24-hour Fluence started just below the Active (1e8 integrated pfu) threshold, but fell through the period. Observed fluence at 08/0001 UTC was 5.65e7 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to remain at Low levels, with a daily chance of isolated M-class flares, most likely from AR3153 or AR3157.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs have been observed in available imagery. Solar wind speeds are at elevated levels, due to the arrival of a HSS from CH53/-. Elevated solar wind speeds will likely persist through Days 1 and 2 (8-9 Dec) before steadily declining through the remainder of the period as the influence from the HSS wanes. Geomagnetic activity is expected to be initially Quiet to Active, with a declining chance of further G1/Minor Storm intervals due to HSS influence. Geomagnetic activity is expected to return to Quiet to Unsettled conditions through Day 2.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is

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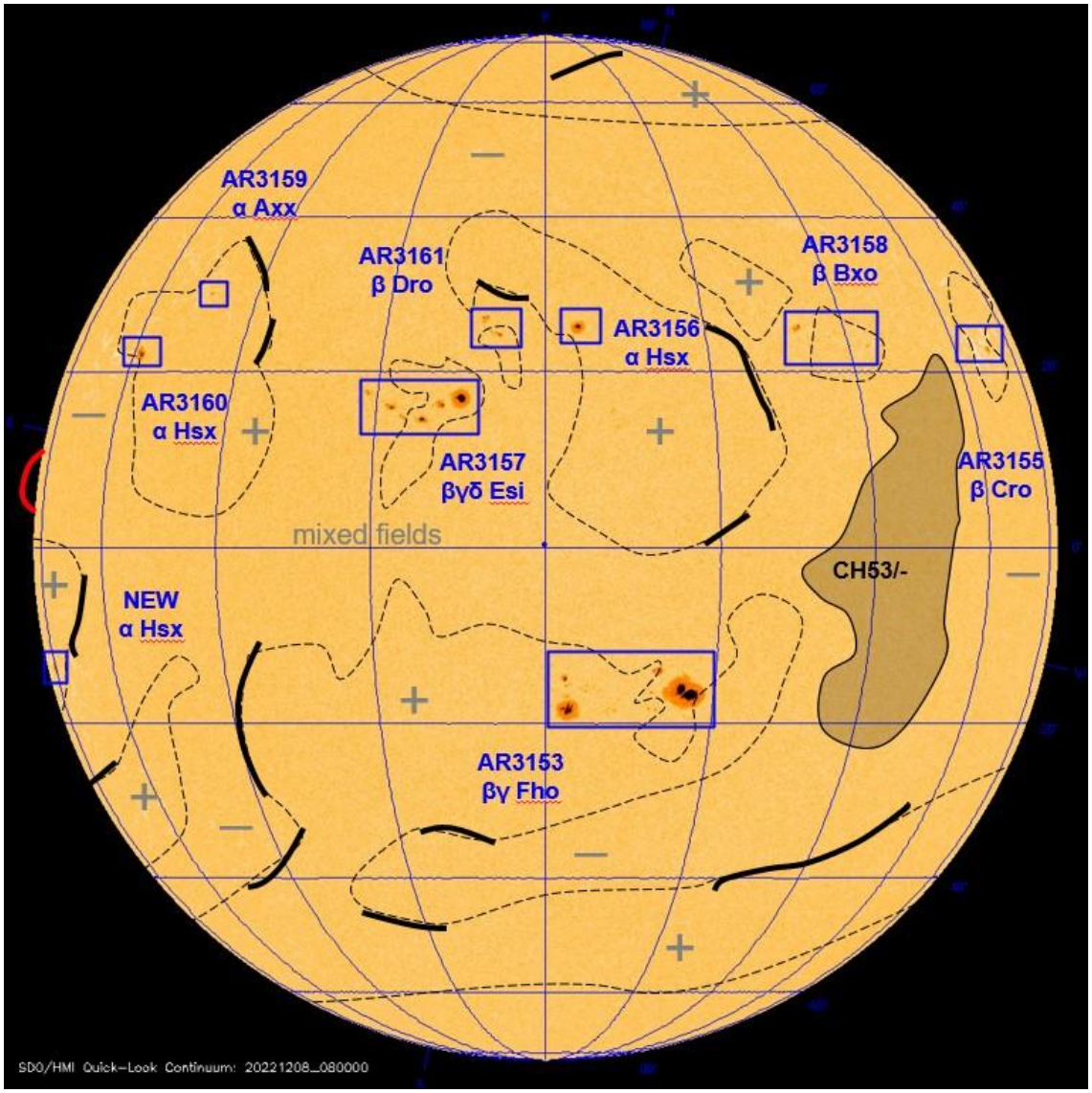
expected to remain at background levels throughout, with a daily slight chance of seeing S1 levels if any significant flares were to occur. High energy electron flux (greater than 2 MeV), as observed by GOES16, was at high levels, but fell to background levels around 07/1745 UTC where it has since remained. Further charging from the current HSS is possible, so electron flux levels may well start to rise again from Day 2 (9 Dec).
Electron fluence is currently declining but a recovery is possible from Day 2 (9 Dec) with a chance of Active (1e8 integrated pfu) conditions by Day 3.

Figure 1. Solar Analysis Valid 08/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs have been observed in available imagery.

Solar wind speeds have gradually increased to elevated levels, due to the arrival of a HSS from CH53/-. This is a large coronal hole which dominates the western disc, and is a recurrent feature which is larger and much more pronounced relative to the last rotation. Uncertainty as to the effect of this feature stems from these changes, as well as the temporal proximity to the solstice and bi-annual minima of the geomagnetic effect of high speed streams. Elevated solar wind speeds will likely persist through Days 1 and 2 (8-9 Dec) before steadily declining through the remainder of the period as the influence from the HSS wanes. MOSWOC Enlil suggests a gradual increase in winds through Day 1 (8 Dec) peaking around 550 km/s on Day 2 (9 Dec) before declining, and is currently considered reasonable guidance.

Geomagnetic activity is expected to be initially Quiet to Active, with a declining chance of further G1/Minor Storm intervals due to HSS influence. Geomagnetic activity is expected to return to mainly Quiet to Unsettled conditions through Day 2.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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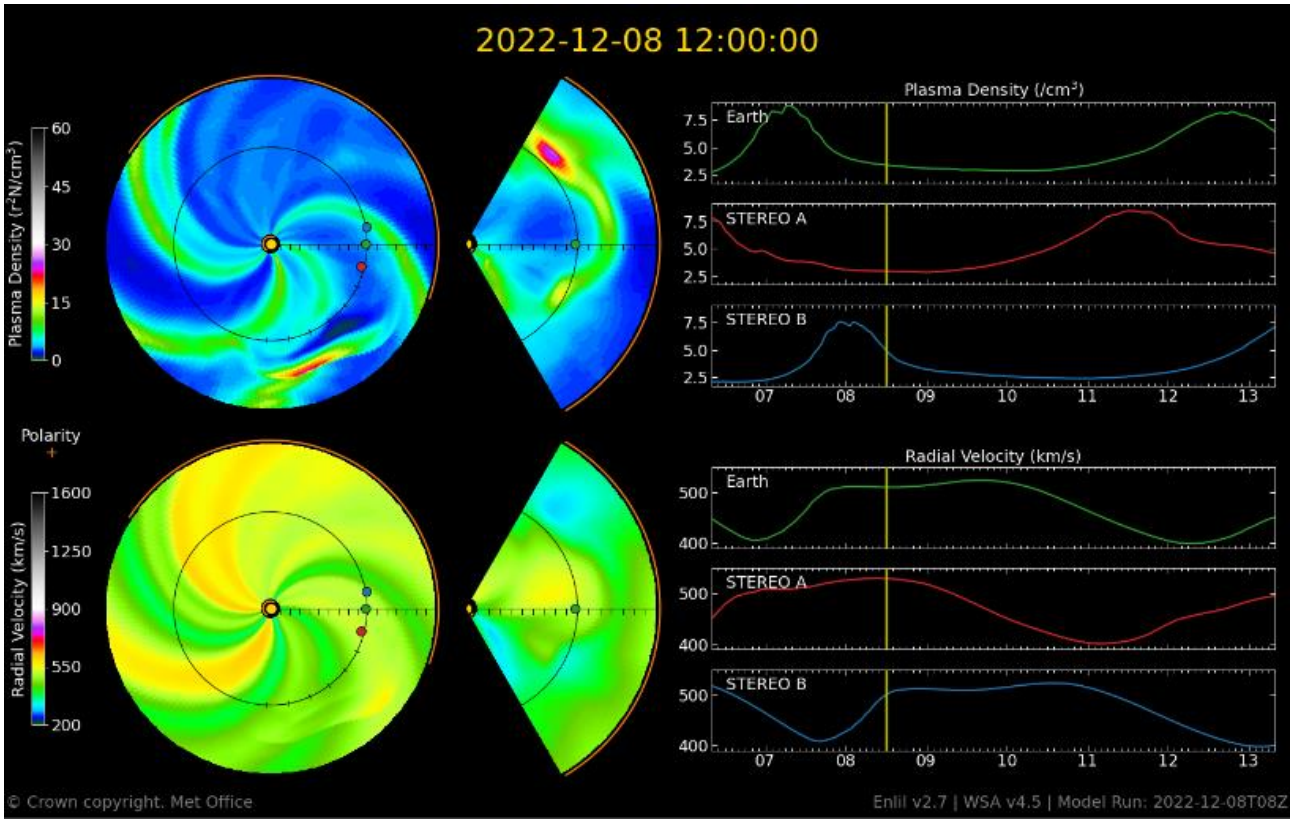
Figure 2: MOSWOC Enlil model, showing continued elevated wind speeds through Day 2 (09 Dec) before a gradual decline. This seems like reasonable guidance.



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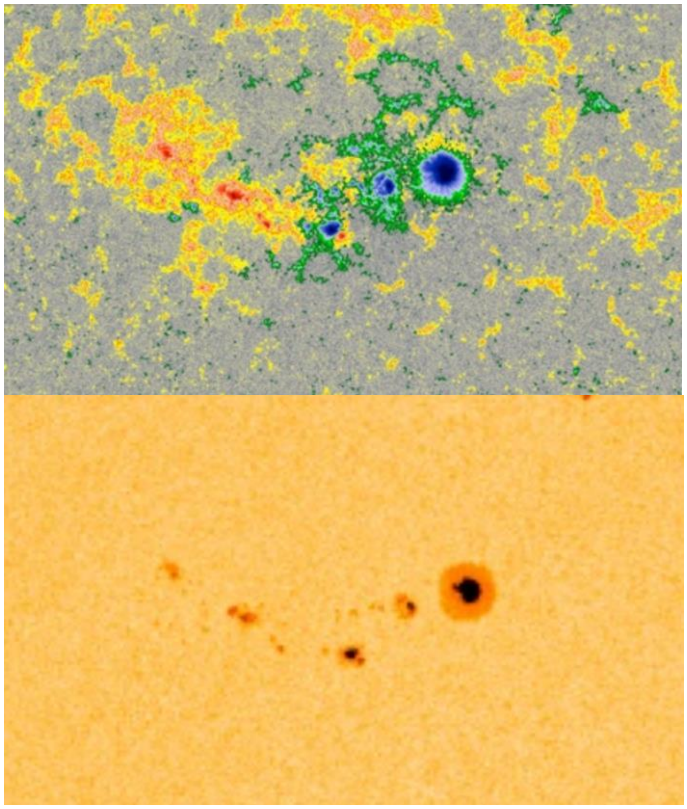
Radio Blackouts - X-Ray Flares:
Solar Activity has been Low over the last 24-hours, with occasional C-Class flares. Activity is likely to remain at Low levels, with a daily chance of increasing to Moderate through the period, most likely from AR3153 or AR3157.

There are currently nine sunspot regions on the visible disc. By far the largest group on the disc remains AR3153 (Fho/Beta-Gamma), now near centre disk. This region has remained relatively stable with only minor flare activity. The second largest spot group, AR3157, (Esi-Beta-Gamma-Delta) in the northeast has developed a small delta spot. The remaining regions all appear stable at present, with some showing slight decay. Despite the suggested complexity of some of the regions on the visible disc, this has so far failed to manifest in significant flare activity.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: SDO intensitygram and magnetogram of AR3157, showing a small delta spot within one of the intermediate spots.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels throughout. However, there remains a daily slight chance of seeing S1 or greater levels at GEO if any significant flares were to occur. This is mainly due to the influence of AR3153 and AR3157 both near centre disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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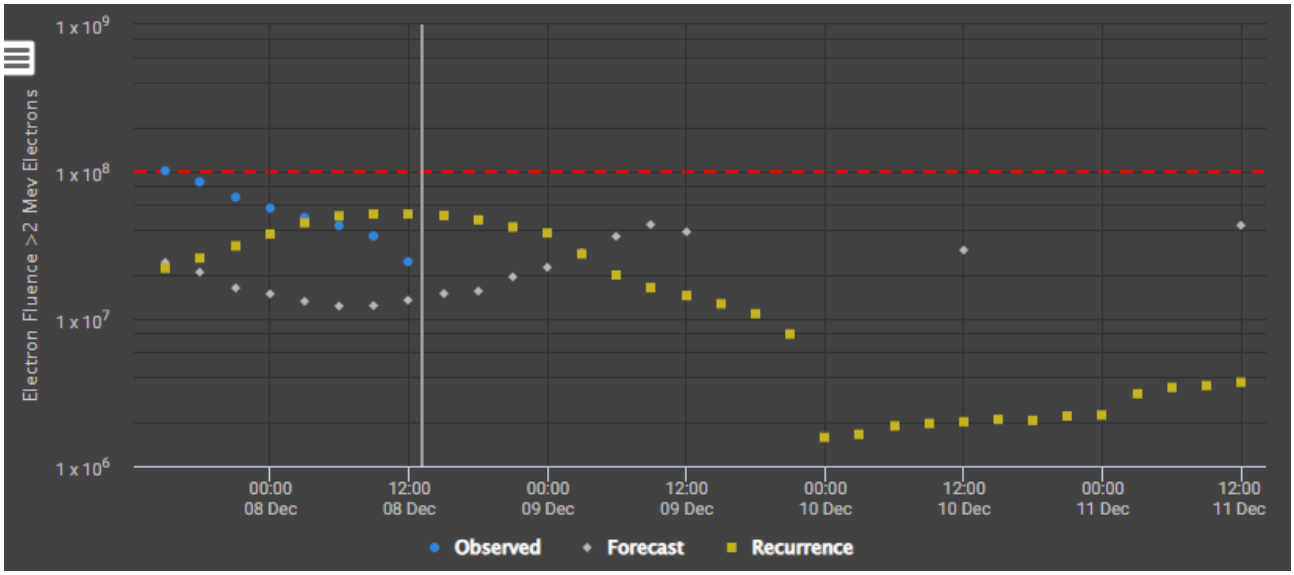
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV), as observed by GOES16, was demonstrating a diurnal oscillation between Moderate and High flux levels, but fell to Background levels around 07/1745 UTC where it has since remained. This is likely as a result of geomagnetic activity from the arrival of CH53/-, perhaps combined with some transient influence. Further charging from the current HSS is possible, so as this wanes and the radiation belt decompresses, electron flux levels may well start to rise again from Day 2 (9 Dec).

Electron fluence is currently declining after the flux dropped out. However, a recovery is possible from Day 2 (9 Dec) with a chance of Active (1e8 integrated pfu) conditions by Day 3. MOSWOC REFM is suggesting a recovery in fluence levels, although below the Active threshold. Confidence in the likelihood of a recovery of electron levels is moderate, but is low for the timing of any increase, as the driving coronal hole during the period is much-changed from the last rotation.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	20	40	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a slight increase in fluence, but remaining below the Active (1e8 integrated pfu) threshold.



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